APPENDIX 11—WATER QUALITY AND WATERSHED MANAGEMENT WITHIN THE RMPPA

DESCRIPTION OF SUB-BASINS IN THE RAWLINS FIELD OFFICE

The State of Wyoming issues a summary report to meet requirements of Section 305(b) and 303(d) of the Clean Water Act for threatened or impaired water bodies. This section includes excerpts and summaries for areas within the Rawlins Field Office (RFO) (Wyoming 2006b). The most current 303(d) list of threatened or impaired water bodies in the Resource Management Planning Area (RMPPA) is shown in Table A11-1.

This section draws heavily from the Wyoming description of these basins (Wyoming 2006b). It also contains local information from the Rawlins Bureau of Land Management (BLM) on conditions and management practices that reflect current conditions. The reader should be aware that these descriptions are as current as possible for 2006; most likely they will not be accurate for future purposes. These are presented to give the reader a qualitative impression of typical water quality conditions in the RMPPA.

Muddy Creek Sub-Basin (Hydrologic Unit Code 14050004)

The upper portions of Muddy Creek and McKinney Creek to the confluence of Eagle Creek have been listed as having threats based on habitat degradation for non-game fish, coldwater fish, and aquatic life. Changes in upland runoff, hydrology, or increased sedimentation could reduce habitat for non-game fish, coldwater fish, and aquatic life. Habitat for these species includes pools and riffles. With increased sediment loads, riffles can become silted in and pools can fill, degrading the habitat for aquatic organisms. Changes in upland runoff can increase peak flow conditions and may reduce base flows critical for maintaining late-season pool habitats. Current road densities in these areas are less than 2 miles/mile^2, and account for a relatively small amount of sediment delivery compared to future plans. Changes in grazing practices have generally improved vegetation conditions and improved rainfall/runoff conditions.

Watershed restoration projects in this sub-basin have been implemented in the Grizzly Wildlife Habitat Management Area (WHMA), which includes the upper Littlefield Creek drainage and other portions of the upper Muddy Creek drainage. In the Grizzly WHMA, the Wyoming Game and Fish Department (WGFD) has been working with the BLM, the grazing permittee, and the Little Snake River Conservation District (LSRCD) to implement similar measures. However, the grazing strategy is to defer grazing for several years to enable willow to better reestablish itself.

Water development projects have been implemented on the reach of Muddy Creek lying west of Highway 789 to address physical degradation of the stream channel, which threatens its aquatic life support. This reach of Muddy Creek is also on Table C of the 303(d) list (Wyoming Department of Environmental Quality [WDEQ] 2006). Implementation measures include wetland development, reestablishment of the floodplain, and irrigation water management. According to LSRCD, results of this project show an improving trend in riparian condition and bank stability above Red Wash.

However, the BLM and LSRCD have identified habitat degradation as a serious water quality concern on Muddy Creek, from Red Wash downstream to the Little Snake River. Habitat degradation is likely caused by season-long riparian grazing that is exacerbated by accelerated erosion associated with oil and gas activities. Several grazing management best management practices (BMP) are being implemented in

much of this lower watershed. These practices include changes in length, timing, and duration of grazing, and cross fencing. WDEQ states, "…projected increases in CBNG development have the potential to lead to increased surface disturbance and possible increased erosion and sediment loading" (WDEQ 2006b).

The principal goal of the "Riparian-Wetland Initiative for the 1990s" was to restore and maintain riparian-wetland areas so that at least 75 percent are in proper functioning condition by 1997. The Muddy Creek Riparian Showcase Area in Wyoming is an example of a river community using this initiative. It has the involvement of the BLM, Natural Resources Conservation Service (NRCS), Little Snake River Conservation District, Carbon County Extension, Wyoming Game and Fish Department, Seeking Common Ground, private landowners, and others. It continues to operate effectively to address management of the Upper Muddy Creek Watershed.

Little Snake Sub-Basin (Hydrologic Unit Code 14050003)

Haggarty Creek is the site of an inactive copper mine, the Ferris-Haggarty/Osceola Tunnel, which dates from 1898. Haggarty Creek originates near the Continental Divide and confluences with Lost Creek to form West Fork Battle Creek. Haggarty Creek has been on past 303(d) lists due to metal exceedences (primarily copper with less toxic amounts of silver and cadmium) discharging from the Ferris-Haggarty Mine. Review of data during the total maximum daily load (TMDL) process on Haggarty Creek revealed that copper criteria are also exceeded on the West Fork of Battle Creek, downstream of Haggarty Creek, so this stream was added to Table A of the 303(d) List. The treatment of the Ferris-Haggarty/Osceola Tunnel effluent is thought to be more than adequate to allow the West Fork of Battle Creek to meet standards. Haggarty Creek and the West Fork of Battle Creek are Class 2AB streams. The impairments are due to priority pollutants.

Savery Creek Drainage (Hydrologic Unit Code 1405000302)

WDEQ monitoring indicates that aquatic life uses are fully supported on the portions of Savery Creek and North Fork Little Snake drainages within the National Forest, and on much of the upper watershed of Little Savery Creek. However, physical degradation of lower Savery Creek and West Loco Creek is threatening full aquatic life use support. These streams are on Table C of the 303(d) List. Recently, LSRCD completed a Section 319 watershed improvement project.

Upper North Platte Sub-Basin (Hydrologic Unit Code 10180002)

The states of Nebraska, Wyoming, and Colorado, and the U.S. Department of the Interior, signed a Cooperative Agreement on July 1, 1997, to address several Endangered Species Act (ESA) issues affecting water development in the Platte River Basin.

The species of concern in the Platte River system are the whooping crane, interior least tern, piping plover, and pallid sturgeon. A programmatic approach was developed to protect the hydrology required to maintain critical habitat for these species in Nebraska (USDI, BLM 1999). This programmatic approach addressed small depletions of less than 25 acre feet per year. A fund was set up to account for these small depletions. For larger depletions, an individual consultation is required.

A governance committee comprised of members from the three states, the Federal Government, environmental interests, and water users was formed in 1997 to develop a program for addressing depletions in the Platte system. The primary components of the program are a water plan, land plan, and adaptive management plan which include an integrated monitoring and research plan. The program will

be implemented incrementally; the first increment will occur over the next 13 years (http://www.platteriver.org).

Water development for BLM range in the Platte River Basin is less common because of fully appropriated water rights in most of the basin. Most of the irrigated agriculture that is near RFO BLM-administered lands is in this basin. This system has two large reservoirs (Seminoe and Pathfinder) that regulate flows of the North Platte and that store water for municipal and agricultural use. There is at least one transbasin diversion from the Colorado River system to the Platte River system in Wyoming to meet municipal water uses in Cheyenne.

Oil and gas activities and mineral development (specifically coal mining and natural gas extraction from coals) typically dewater geologic formations to extract resources. In the Platte River system, this will likely add non-tributary water from these formations to the Platte River system. Reasonably foreseeable development includes the discharge of significant amounts of water into the Platte River system subject to State approval. All water discharged must be approved by the State of Wyoming under its National Pollutant Discharge Elimination System (NPDES) Program (http://deq.state.wy.us/wqd/).

Depletions from other activities such as oil and gas development will be addressed for individual projects during the National Environmental Policy Act (NEPA) process. In addition, consultation with the Recovery Program and/or the U.S. Fish and Wildlife Service (USFWS) would be initiated for potential depletions identified during project planning.

Water is used for drilling operations, hydrostatic testing of pipelines, and dust abatement. The source of this water can vary, but direct withdrawals from surface waters are generally not used, with the exception of large pipeline projects. Common potential sources include municipalities (Baggs, Rawlins, Wamsutter) or state-approved wells. Water produced during oil and gas activities may result in depletions if there are connections between the producing geologic formation and surface waters. Methods for making this determination can include isotopic analysis, water quality data, and/or groundwater modeling. Water quality and water pressure data can be used to evaluate the homogeneity of groundwaters in formations and to confirm or deny assumptions made by the other methods. A combination of these approaches, depending on the scale or likelihood of the potential connection to surface waters, will be used to determine if groundwater is tributary and may result in depletions to surface waters.

Encampment River Watershed (Hydrologic Unit Code 1018000205)

The Encampment River originates in the Mt. Zirkel Wilderness area in Colorado before it flows into Wyoming. Within a couple miles, it flows into the Encampment River Wilderness Area. Assessment by DEQ indicates full aquatic life use support in the Encampment River and North Fork Encampment River. Flows are augmented in the Encampment River drainage due to a trans-basin diversion of water from the Little Snake drainage into Hog Park Reservoir for replenishing the North Platte water that Cheyenne diverts out of Douglas Creek. The increased flows in Hog Park Creek did cause some initial channel adjustment after the reservoir was completed in 1965, but the stream appears to be stabilizing. South Hog Park Creek was tie driven, carried a large sediment load, and was unstable. Therefore tree revetments were installed to help the stream establish a more natural shape and to improve the fishery. But beaver were removing revetments for dam building, because dams built with the small available willows could not withstand high spring runoff. Aspens are now being cut and hauled to the beaver so they will use the aspens instead of the revetments. In this way both can work to trap the sediment and restore the stream.

The North Fork of the Encampment River is the drinking water source for the Town of Encampment. Potential development of a Green Mountain resort and mountain community within the watershed resulted in the Town of Encampment obtaining Section 205(j) assistance funds to develop a Source Water

Protection Plan. Additional monitoring and assessment work is a component of that project. The BLM recently changed grazing management on portions of Centennial Creek to improve riparian conditions. The Saratoga Encampment Rawlins Conservation District (SERCD) has conducted monitoring on Jack Creek, below the National Forest, and the data indicate it is also fully supporting its aquatic life uses.

Sage Creek Watershed (Hydrologic Unit Code 1018000209)

Sage Creek has a naturally high sediment load due to the highly erosive soils and arid climate in much of the watershed. Several studies have identified it as the most significant contributor of sediment to the Upper North Platte River. (It is on Table C of the 303(d) List.) Additionally, dam failures, road building, and past grazing practices have resulted in increased erosion and sediment loading, especially from the lower portion of the watershed. In 1997, SERCD, in cooperation with land owners, BLM, NRCS, and WGFD, began the Sage Creek Watershed 319 project, which now encompasses the entire watershed. The project uses a combination of short-duration grazing, riparian and drift fencing, off-channel water development, improved road management, grade control structures, and water diversion and vegetation filtering to reduce sediment loading from Sage Creek to the North Platte. Another project aim is to improve water quality within Sage Creek. Data collected as part of the project already show reduced sediment loading to the North Platte River and improved riparian and range condition.

Pathfinder-Seminoe Sub-Basin (Hydrologic Unit Code 10180003)

In the Pathfinder-Seminoe Sub-basin, North Platte River flow is regulated by Seminoe, Kortes, and Pathfinder Reservoirs. The sub-basin includes those areas, other than the Sweetwater and Medicine Bow Rivers, which drain into the North Platte River, or its reservoirs, between Pathfinder Dam and the head of Seminoe Reservoir. Primary land uses in this sub-basin are grazing, irrigated hay production, coal mining, and recreation. Underground coal mining began in the Hanna-Elmo area in the late 1860s to supply fuel for the transcontinental railroad, and resulted in extensive underground coal workings created over a period of years. The WDEQ-Abandoned Mine Lands Division completed three remediation projects in the Hanna area. These projects corrected the erosion and standing water impacts associated with coal slag piles and almost 200 coal mine-related subsidence holes. WDEQ states, “Current coal mining activities are thought to have little impact on the water quality in this sub-basin or the Medicine Bow Sub-basin (HUC 10180004).”

Pathfinder Dam was completed in 1909, and provided the first regulation of flows on the river. Reservoirs also trap sediment and lower average water temperature, so the natural flow characteristics of the North Platte have not existed since. An extremely productive tailwater fishery resulted after Seminoe Dam was completed in 1939; it was given the name Miracle Mile. Completion of Kortes Reservoir below Seminoe Dam shortened the Miracle Mile area, but with the establishment of instream flow releases, it is still considered a premiere blue ribbon fishery. Deweese Creek, which flows into Pathfinder Reservoir, is one of the few perennial streams in this sub-basin. DEQ considers it as a reference stream for sand bottom streams in the Wyoming Basin Ecoregion.

Medicine Bow Sub-Basin (Hydrologic Unit Code 10180004)

The headwaters of the Medicine Bow Sub-basin are on the north slope of the Snowy Range. Water quality characteristics change drastically as the streams flow from the metamorphic geology of the mountains through the easily erodible, fine-grained sedimentary geology of the basin. This sub-basin drains into Seminoe Reservoir. Land uses include logging in the mountains, grazing, irrigated hay production, recreation, coal mining, and oil and gas development. Coalbed natural gas (CBNG) development is beginning in the watershed. Irrigation in the Medicine Bow River drainage (including Rock Creek) dates

to at least 1870–1880, the time of railroad construction. The Transcontinental Railroad reached this area in 1868, and coal production began in 1869 near Carbon to supply fuel for the railroad. AML has completed 10 site investigations in this sub-basin, most related to coal and gravel production, and completed remediation of one early-1900s coal mine. Water quality assessments conducted in the upper Medicine Bow River drainage above the Town of Elk Mountain indicate full support of aquatic life uses. Extensive monitoring by DEQ, as well as by several agencies and universities, also indicate full aquatic life use support in the Rock Creek drainage above McFadden.

Little Medicine Bow Sub-Basin (Hydrologic Unit Code 10180005)

The Little Medicine Bow Sub-basin drains the northwestern edge of the Laramie Mountains and the Shirley Basin. Land uses primarily are grazing and oil and gas development, together with historic uranium mining (1955 to the early 1980s). AML completed reclamation of about 1,650 acres of open-pit uranium mines in Shirley Basin. The Little Medicine Bow River originally flowed through the uranium ore location. During mining operations in 1972, the river was diverted to the east and shortened. The unstable new channel had down cut as much as 50 feet and drastically increased the sediment input to the drainage system. During reclamation, the river channel was restored to its former location and pre-mining condition, with stabilized, revegetated banks and a revegetated riparian area. Eroding radioactive mine waste piles which also contained elevated levels of selenium and heavy metals were removed. Leaching and runoff water from these waste piles had been impacting surface and ground water quality. Reclamation improved water quality and reduced off-site sediment transport.

Upper Laramie Sub-Basin (Hydrologic Unit Code 10180010)

This sub-basin includes all the drainages above Wheatland Reservoir #2. Major drainages in the Upper Laramie Sub-basin are the Laramie and Little Laramie Rivers, whose headwaters are in the Medicine Bow Mountains. Land uses are logging, recreation, grazing at higher elevations, grazing, irrigated hay production, and some oil and gas development in the lower elevations. The City of Laramie (third largest in Wyoming) lies in this sub-basin. Extensive water quality assessments by universities, the Forest Service, and DEQ in the Little Laramie Drainage above Millbrook indicate that the majority of the streams and lakes are meeting their aquatic life uses.

Table A11-1 lists water bodies facing impairments or threats.

Table A11-1. 2006 303(d) Waterbodies with Impairments or Threats

Surface Water	Impairments or Threats	Location	Impairments/ Threats	Use Impaired/ Threatened	Date	Priority
Colorado River Basin – Muddy Creek (HUC 14050003) and Savery Creek (HUC 14050004)						
Muddy Creek	Threats	West of State Highway 789	Habitat degradation	Non-game fish; aquatic life	1996	Moderate
Muddy Creek	Threats	Above Alamosa Gulch to Littlefield Creek	Habitat degradation	Cold fish; aquatic life	1996	Moderate
McKinney Creek	Threats	Above Muddy Creek to Eagle Creek	Habitat degradation	Cold fish; aquatic life	1996	Moderate
Savery Creek	Threats	Below Little Sandstone Creek to Little Snake River	Habitat degradation	Cold fish; aquatic life	1998	Moderate
Loco Creek West Fork	Threats	All of West Fork Watershed above Loco Creek	Habitat degradation; nutrients; temperature	Cold water fishery; aquatic life	1996	Moderate
Haggarty Creek	Impairments	From Ferris-Haggarty Mine to West Fork Battle Creek	Copper, silver, and cadmium	Cold water fishery; aquatic life	1996	High
West Fork Battle Creek	Impairments	From Battle Creek to Haggarty Creek	Copper	Cold water fishery; aquatic life	2000	High
Green River Basin – Bitter Creek in (HUC 14040105)						
Bitter Creek	Impairments	From Green River to Killpecker Creek	Fecal coliform; Chloride	Contact recreation; non-game fish; aquatic life	2000, 2002	Low
Missouri River Basin - South Platte (HUC 1019009)						
Crow Creek	Impairment	Above and below Cheyenne	Ammonia; fecal coliform	Fisheries; aquatic life and contact recreation	1996	Low
North Platte River	Impairments	Water bodies associated with the Kendrick Reclamation Project and undetermined distance up and downstream on the North Platte from Casper	Selenium	Cold fish; aquatic life; wildlife	1998	Low
Rock Creek	Impairments	Above the town of Wheatland	Fecal coliform	Contact recreation	2002	Low
Wheatland Creek	Impairments	Undetermined distance above and below Highway 320.	Fecal coliform	Contact recreation	2002	Low

Surface Water	Impairments or Threats	Location	Impairments/ Threats	Use Impaired/ Threatened	Date	Priority
Sage Creek	Threats	From confluence with North Platte River to State Highway 71	Habitat degradation	Cold fish; aquatic life	1996	Low
Chugwater Creek	Threats	Above irrigation diversion in the NE1/4SW1/4 S26 T25N R67W upstream an undetermined distance below Antelope Gap Road.	Habitat degradation; sediment	Cold fish; aquatic life	2000	Low
Crow Creek	Impairment	Above and below Cheyenne	Ammonia; fecal coliform	Fisheries; aquatic life; contact recreation	1996	Low

Source: Compiled from WDEQ (2006a)

WATER QUALITY AND WATERSHED MANAGEMENT

Depletions to River Systems Resulting from BLM-Approved Activities

Depletions are the amount of water in a river system that is unavailable to fish, plant, or wildlife species as a result of water development or use. Depletions are typically calculated based on a monthly mass balance calculation. Therefore they can include water that is stored in headwaters and/or water lost through consumptive use or evaporation.

The Colorado River System has regional management plans and a recovery program, which began in 1988, to address depletions (Roehm 2004). An EIS for the cooperative agreement for a recovery program is in draft form (USBOR and USFWS 2004); the agreement and final EIS are likely to be released by the time this document is released. Because the Great Divide Basin is a closed basin with internal drainage, there are no impacts to river systems with threatened or endangered species requiring consideration of depletions resulting from BLM management actions.

The RFO participates in management plans and the recovery program for the Colorado River as well as the interim policy in the Platte River Basin. NEPA analysis addresses any BLM-approved project that results in a federal nexus (requiring federal approval because of the use of federal resources including minerals or land use) that may result in depletion to these systems. If required, the BLM will consult with the USFWS on these depletions and potential impacts to protected species.

The use of water during oil and gas well drilling and operation activities has been estimated based on the average volume of water used per well: 1.1 acre feet per well for conventional gas wells and 0.3 acre feet per well for CBNG wells. This figure is multiplied by the estimated number of conventional and CBNG wells, anticipated over the next 20 years for each water basin. Within the Colorado River Basin, 1,444 conventional gas wells and 1,708 CBNG wells are anticipated. Within the North Platte River Basin, 223 conventional gas wells and 1,407 CBNG wells are anticipated. Well construction activities include well drilling and completion operations, hydrostatic testing for local pipelines, and dust abatement.

Although these figures estimate total water usage by well construction activities, they do not necessarily represent water depletions. For example, frequently only a portion of water used in well construction and operation activities is lost from the system. Additionally, the source of water used for well construction and operation activities varies greatly by project and can include off-site or groundwater sources that do not necessarily result in the depletion of surface waters. Actual depletion amounts are calculated based on the details and specifics of individual projects. These potential depletions will be considered at the project level when these details can be determined.

The next sections discuss depletions for the Colorado and Platte River systems.

Colorado River System

A Biological Opinion (BO) was issued in 2000 to cover Colorado River depletions from livestock watering facilities. It was determined that individual projects causing 100 acre ft or less of average annual depletion would be included in a programmatic approach, while projects greater than 100 acre ft would still be addressed by individual consultation (USFWS 2002). The recovery program was established in 1988 based on the needs of the endangered Colorado pikeminnow (*Ptychocheilus lucius*), endangered humpback chub (*Gila cypha*), endangered bonytail (*Gila elegans*), endangered razorback sucker (*Xyrauchen texanus*), as well as designated critical habitat for these fish.

Potential project-related depletions to the Little Snake River are considered for the Yampa River Basin Management Plan and the recovery program for Colorado River native fish downstream (http://www.r6.fws.gov/crrip/). This program is a joint effort between Wyoming and Colorado to account for water development projects that lead to depletions. As projects occur on BLM land or need right-of-way actions across BLM land, they will be evaluated to consider adequacy under the Yampa River Basin Management Plan if it is adopted. Most of the projects mentioned in the Yampa River Management Plan will be initiated by the State of Wyoming and/or local water conservancy districts.

Reservoirs greater than 2 to 2.5 acres in surface area would likely result in greater that 1 acre foot of evaporation per month in the mid-summer. Therefore they would result in greater than 1 acre foot of depletions to the local system. This evaporation can be calculated using the free water surface evaporation rate during the period between May and October (30–35 inches), and dividing by 6 months, to yield 0.42–0.49 feet/month. Data from the 2004 Wyoming Climate Atlas was used (Curtis, 2004). Because depletions are calculated on a monthly budget, it is reasonable to use this value and assume the highest range in the peak of the summer.

Depletions from other activities such as oil and gas development are handled for individual projects and considered during the NEPA process. Water is used for drilling operations, hydrostatic testing of pipelines, and dust abatement. The source of this water can vary but direct withdrawals from surface waters are generally not used, with the exception of large pipeline projects. Common potential sources include municipalities (Baggs, Rawlins, Wamsutter) or state-approved wells. If it is determined that water sources are tributaries to the surface waters in question, depletions would be consulted on with the USFWS. For large pipeline projects, this would be done during the EIS planning process. Produced water during oil and gas activities is evaluated during the NEPA process to determine potential connections between the producing geologic formation and surface waters. Methods for making this determination can include isotopic analysis, water quality data, and/or groundwater modeling. Consultation with USFWS would be initiated for any depletions identified during project planning.

Platte River System

The species of concern in the Platte River system are the whooping crane, least tern, piping plover, and pallid sturgeon. A programmatic approach was developed to protect the hydrology required to maintain critical habitat for these species in Nebraska (USDI, BLM 1999). This programmatic approach addressed small depletions of less than 25 acre feet per year. A fund was set up to account for these small depletions. For larger depletions, an individual consultation is required.

Water development in the Platte River Basin is less common because of fully appropriated water rights in most of the basin. Most of the irrigated agriculture that is near RFO BLM-administered lands is in this basin. Further, this system has two large reservoirs (Seminoe and Pathfinder) that regulate flows of the North Platte and that store water for municipal and agricultural use. There is at least one transbasin diversion from the Colorado River system to the Platte River system in Wyoming to meet municipal water uses in Cheyenne.

Oil and gas activities and mineral development (specifically coal mining and natural gas extraction from coals) typically dewater geologic formations to extract resources. In the Platte River system, this will likely add non-tributary water from these formations to the Platte River system. Reasonably foreseeable development includes the discharge of significant amounts of water into the Platte River system subject to State approval. Although some anticipated actions have not been approved, some of this non-tributary water may be available to meet species needs downstream.

All non-tributary water added to the Platte system needs to be accurately measured to meet species needs. Such water would be discharged above Seminoe and Pathfinder reservoirs, and therefore managed for this use using reservoirs along the North Platte. The State of Wyoming must approve all water discharged under its National Pollutant Discharge Elimination System (NPDES) Program (http://deq.state.wy.us/wqd/). This program requires that water quality not be degraded below numerical requirements for beneficial uses specified for the water bodies receiving the discharges or located below the discharges. Seminoe Reservoir and the North Platte River are water quality classification 2AB, which is the highest numerical standard and protects game fish and drinking water. Portions of the North Platte River (Miracle Mile and the headwaters) are considered class 1 waters; this means the water quality cannot be degraded by point source discharges.

Depletions from other activities such as oil and gas development are handled for individual projects and considered during the NEPA process. Water is used for drilling operations, hydrostatic testing of pipelines, and dust abatement. The source of this water can vary but direct withdrawals from surface waters are generally not used, with the exception of large pipeline projects. Common potential sources include municipalities (Baggs, Rawlins, Wamsutter) or state-approved wells. If it is determined that these sources are tributaries to the surface waters in question, depletions would be consulted on with the USFWS. For large pipeline projects this would be done during the EIS planning process. Produced water during oil and gas activities is evaluated during the NEPA process to determine potential connections between the producing geologic formation and surface waters. Methods for making this determination can include isotopic analysis, water quality data, and/or groundwater modeling. Consultation with USFWS would be initiated for any depletions identified during project planning.

For projects involving large amounts of groundwater, groundwater modeling that considers geology and any data available from local wells will be used to evaluate impacts, including surface waters. Isotopic analysis can be used to determine when water was deposited in groundwater formations and whether the waters are tributary to surface waters. Water quality data along with water pressure can be used to evaluate the homogeneity of groundwaters in formations and to confirm or deny assumptions made by the other methods. A combination of these approaches depending on the scale or likelihood of the potential connection to surface waters will be used to determine if groundwater is tributary. If groundwater use is from tributary systems, it will be considered a depletion, and consultation will occur with the USFWS.

Escherichia coliform Bacteria and Water Quality

Total coliform bacteria are a collection of relatively harmless microorganisms that live in large numbers in the intestines of man and other warm-blooded and cold-blooded, animals. They aid in the digestion of food. A specific subgroup of this collection is the fecal coliform bacteria, the most common member being *Escherichia coliform* (*E. coli*). These organisms may be separated from the total coliform group by their ability to grow at elevated temperatures. They are associated only with the fecal material of warm-blooded animals.

Potential water quality impacts from *E. coli* bacteria that can be present in animal feces and cause human health impacts were evaluated using information on http://www.epa.gov/surf/. The evaluations determined any potential RFO watersheds that would be upstream of streams listed in Wyoming or other states on the 303(d) list for *E. coli* or fecal coliform (Table A11-2).

Table A11-2. *Escherichia coliform* Bacteria and Water Quality

Watersheds with Potential Headwaters in the RFO	Hydrologic Unit Code (HUC) Number	Upstream Contribution from the RMPPA? (Y/N), and What State it Flows into	Any Water Bodies Listed in Wyoming for *E. coli* or Fecal Coliform? (Y/N)	Any Water Bodies Listed in Other States for *E. coli* or Fecal Coliform? (Y/N)
Upper Bear	16010101	N, Utah	Y	Only in Wyo.
Muddy Creek	14040108	N, Utah	N	N
Blacks Fork	14040107	N, Utah	Y	N
Upper Green-Flaming Gorge Reservoir	14040106	N, Utah and Colorado	N	N
Vermilion	14040109	N, Colorado	N	N
Lodgepole	10190015	N, Colorado	N	N
Bitter Creek	14040105	Y, Colorado	Y	N
Chugwater Creek	10180011	Y, Nebraska	Y	N
Crow Creek	10190009	Y, Colorado and Nebraska	Y	N

Chugwater Creek, Bitter Creek, and Crow Creek are listed for Fecal Coliform in Wyoming. However, only a small portion of these watersheds contain public land in the RMPPA. For example, Crow Creek is within the RMPPA and listed for *E. coli* in Wyoming. However, BLM has less than 10 sq mi of land to manage in the watershed (less than 1 percent), with the majority being private, forest service, and state lands. Most of BLM-managed land is in Middle Crow Creek, about half the watershed is in the North Crow Creek allotment, with mixed land ownership, and the Forest Service manages the rest of the watershed upstream. About one linear mile of Middle Crow Creek is on BLM-administered lands. There are no streams listed for *E. coli* or fecal coliform in states downstream from the RMPPA.

Streams with the potential to be listed for bacteria, and located downstream from the RMPPA as identified by public comments, included the following:

- Middle Creek (WBID number COUCYA13b) is in the Upper Yampa watershed and does not have tributaries in Wyoming.
- Main stem of Dry Creek (WBID number COUCYA13d) is in the Upper Yampa watershed and does not have tributaries in Wyoming.
- Main stem of Muddy Creek (WBID number COUCUC07b) is in the Upper Colorado watershed and does not have tributaries in Wyoming.

Intensive Management of 303d-Listed Waterbodies

The State of Wyoming is tasked with administering the clean water act, if and when an exceedence in water quality standards occurs; and if it is determined to be chronic, the BLM and other potentially responsible parties would then participate in a 303d listing and hopefully a delisting process designed to address the problem. The delisting process typically involves forming a 319 funded group, collecting baseline data, identifying actions that will allow for delisting, and specifying a water quality goal or criteria that will signal the appropriateness of delisting. Standards for Rangeland Health (USDI, BLM

1997) require the evaluation of rangelands to determine if the watersheds, where they are located, are meeting state water quality standards. If they are not meeting the standards as a result of BLM actions such as livestock grazing, oil and gas development, etc., the BLM is tasked with changing this management. Changes to management can be implemented via new allotment management plans that change the season of use, amount of grazing, increase water source and/or other grazing management actions to reduce impacts. Such allotment management plans would be developed in coordination with the grazing lessee. If impacts are a result of oil and gas activities, more stringent requirements for addressing erosion impacts from surface disturbance may be implemented, such as requiring more culverts on an oil and gas road, funding a headcut remediation project, or other appropriate management actions that address impacts from this activity.

Reservoir and Dam Safety

A reservoir is a natural or artificial lake or pond in which water is collected and stored to supply the needs of livestock, wildlife, and/or other beneficial uses. The BLM manages small (20 acre-feet or less of water storage and less than 5 acres of surface area) and medium (20 to 2000 acre-feet of water storage and 5 to 200 acres of surface area) reservoirs. Some of the reservoirs are in the State of Wyoming's dam safety program (dike heights of 20 feet or greater or more than 50 acre-feet of storage).

All BLM dams are maintained to standards promoting safe performance and reducing hazards from the dam's possible diminution from an acceptable level. Bureau-wide dam inventory includes a hazard classification (high, significant, and low) for each structure inventoried. A condition assessment should be done depending on the rating (BLM Manual 9177).

All changes to reservoir design or plans to construct new reservoirs will consider the hydrology of the area using surveys and analysis. New construction design and planning will include a soils analysis and consider fish movement if relevant, beneficial uses identified (i.e., wildlife and water storage fishery), site reconnaissance, depletions to downstream systems, changes in hydrology.) Reservoirs should be designed, constructed, and maintained to meet beneficial uses identified during planning (BLM Manual 6721).

Dam structures should be inventoried and reviewed as part of this process. Dams that do not currently support the resource management programs should be removed from service to reduce the BLM's liability and maintenance needs (BLM Manual 9177).

Options for rehabilitating or reclaiming reservoirs include breaching the dam and reclamation of the reservoir pool, re-building the reservoir to original specifications, or redesigning the reservoir to meet new uses or improve operations for historical uses. Management of the sediment collected in the pool is the most important consideration in removing instream structures. Four alternatives for project retirement are (ASCE, 1997):

- **No Action—**Leave the existing sediments in place.
- **River Erosion—**Allow the stream to naturally erode the sediments from the reservoir.
- **Mechanized Removal—**Removal of the sediment using mechanical equipment such as dredges.
- **Stabilization—**Modify the project facilities and design to protect sediments from erosion.

These four approaches can be combined; e.g., removing a portion of the sediment to form a stable meandering or armored channel through the pool of the reservoir, and including some type of structure to protect the pool sediment from headward erosion. Each design should be tailored to the long-term management plans for the reservoir site. Another approach would be to rebuild the reservoir to improve the design or so the reservoir serves a new or modified purpose.

Rebuilding reservoirs to original specifications may require some additional engineering, such as providing drainage near the toe of the dam, inserting a low-flow pipe, or rebuilding the spillway. This additional engineering may be required by the State of Wyoming or Bureau of Reclamation for dam safety, result from better knowledge that was unavailable when the dam was originally constructed, or result from increased potential to threaten infrastructure downstream due to a failure. Management changes or better knowledge of precipitation and flow regimes may also show the necessity for redesign of the structure to collect more or less water in the reservoir.

Effects, risks, and costs to downstream infrastructure and aquatic and cultural assets vary with the management alternatives considered. Release of fine sediment may impair water quality downstream, and the release of courser sediments would cause aggradation, which directly affects flood stages and channel migration. These potential considerations can cause secondary effects to downstream environments, property owners, and water users (ASCE, 1997). When planning for reservoirs and dams occurs, project planning will disclose safety considerations, downstream effects, long-term maintenance costs, and other relevant considerations. Such considerations must be carefully considered before formulation of plans.

Wetland and Floodplain Management

Laws, Executive Orders (EO), and Departmental policy serve to maintain, restore, or improve riparian-wetland ecosystems to achieve a healthy and proper function condition that assures biological diversity, productivity, and sustainability (BLM Manual 1737). In accordance with these, the Clean Water Act of 1987, as amended (33 United States Code 1251), provides for the protection of wetlands, among other natural assets. Protection of Wetlands (EO 11990) requires federal agencies to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. Floodplain Management (EO 11988) provides for the restoration and preservation of national and beneficial floodplain values, and enhancement of the natural and beneficial values of wetlands in carrying out programs affecting land use.

Floodplains are low-lying areas adjacent to perennial streams, dry washes, and ephemeral streams. In the vicinity of the Pilot Project, they may be subject to periodic flooding. Flood Insurance Rate Maps or Flood Hazard Boundary Maps have been developed for portions of the RMPPA (not the entire area). Most 100-year floodplains in the RMPPA would likely occur within 500 ft of perennial waters or 100 ft of ephemeral drainages. As floodplains are identified during onsite investigations, the location of permanent features will avoid them. Flooding in ephemeral drainages is generally in response to high-intensity, localized storms. Such storms cause most of the floodwater damage, surface erosion, arroyo formation, and sediment deposition in arid and semi-arid environments (Branson et al. 1981).

Source Water and Wellhead Protection

The State of Wyoming DEQ identifies source water and wellhead protection areas for public drinking water supplies. Projects subject to BLM approval and/or on BLM-administered lands consider these areas in planning. Both surface and groundwater resources zones are identified for application of BMPs as follows:

- **Accident Prevention Zone 1—**Constitutes a highly protected area around the wellhead or surface water intake. Its purpose is to protect the drinking water source from direct contaminants from spills, surface runoff, or leakage from storage facilities or containers.
- **Attenuation Zone 2—**Established to protect from contact with pathogenic microorganisms (e.g., bacteria and viruses) which can emanate from a source (e.g., septic system) located close to the

well or intake. These areas will provide emergency response time to begin active cleanup and/or implementation of contingency plans should a chemical contaminant be introduced.

- **Remedial Action Zone 3—**Is designed to protect the well or intake from chemical contaminants that may migrate to the well or intake. Zone 3 should be sufficiently large to provide adequate time to detect and respond to a contaminant release.

These protection zones will change in the future as population and drinking water sources change. Currently, the Muddy Creek and North Platte Basins are Zone 3 protection zones. There are isolated groundwater protection zones 1 and 2 near municipalities. The town of Laramie has surface water protection zone 2 areas in the Laramie River watershed to the west of Laramie and fairly extensive groundwater protection areas to the east of town. BLM land management decisions in these areas would consider drinking water supplies. Best management actions as described in Appendix 13 for non-point source pollution would be implemented in these areas.

Playas

Playas are low, flat parts of a basin or other undrained area, typically characterized by depressions with clay bottoms that pool water on the surface and accumulate salts. During wet climate cycles, these areas may contain open water for periods of the year or even many years. These areas should be avoided when locating infrastructure due to poor soils and potential flooding. When infrastructure must be located in a playa, design considerations should be employed to protect the playa, assure accessibility, and not damage infrastructure due to flooding. Methods for designing infrastructure in these areas typically requires site-specific designs. They would in most cases involve limiting excavation that may damage the impervious layer, elevating pads and roads. They also may include culverts to allow water movement through fill. Aerial photographs taken during wet periods, site visits, and USGS Quad maps can all be used to identify playas. They should be considered when locating infrastructure in arid areas with playas.

Monitoring Water Quality and Quantity

Water resource monitoring in the RMPPA is designed and managed to provide BLM with baseline information on water quantity and quality as well as to answer project-specific questions. Monitoring activities include the collection of streamflow data, water samples for analysis, evaluation of stream health conditions, evaluation of springs and other water sources, and evaluation of streamflow conditions. These collective monitoring efforts are helpful in providing information that is used to adjust management within the watersheds and along riparian areas.

Monitoring of water quality and quantity by the BLM is typically undertaken to support aquatic resource management. BLM Manual 6720 describes this monitoring and includes the following policies:

- Inventory, evaluate, and monitor aquatic habitats on public lands to determine existing condition and determine which of these habitats support aquatic vertebrate and macroinvertebrate species.
- Restore, enhance, and protect aquatic habitats by preventing their loss, and implementing and monitoring habitat management or restoration projects.
- Maintain or enhance natural ecosystems functions, such as water flow regimes necessary for aquatic habitat functions.

Monitoring efforts for water quality are shared with WDEQ and conservation districts as appropriate for listing or delisting water bodies on the 303(d) list and other purposes. An example of these efforts

includes an ongoing study of the Sage Creek Watershed completed cooperatively between Saratoga-Encampment-Rawlins Conservation District (SERCD), landowners, WDEQ, and the Rawlins BLM. Another example involves efforts in the Muddy and Savory Creek drainages with the Little Snake River Conservation District (LSRCD).

Coordinated resource management processes like these include monitoring and data collection involving coordination with the BLM, landowners, grazing permittees, WGFD, WDEQ, conservation districts, and other stakeholders to address these water quality and riparian habitat problems. As part of the Coordinated Resource Management (CRM) process on Muddy Creek, 319 watershed improvement projects have been completed in the Upper Muddy Creek drainage. Implementation measures include upland water development, cross fencing, vegetation management, and grazing management.

BLM monitoring methods use established protocols developed by WDEQ to provide quantitative assessments on watershed health and ecosystem integrity. WDEQ has developed the 2004-2008 Water Quality Monitoring Strategies; annual monitoring work plans are available on its website (http://deq.state.wy.us/wqd/). In 1999, Wyoming passed legislation requiring WDEQ to use "credible data" in decisions concerning the attainment of beneficial uses. Credible data, as defined by the Wyoming Legislature, "…includes scientifically valid chemical, physical, and biological monitoring data collected under an accepted sampling and analysis plan, including quality control and quality assurance procedures and available historical data".

The RMPPA is implementing the WDEQ protocols. It is developing an integrated approach to the monitoring and assessment of watershed, aquatic, and riparian ecosystem conditions within areas that are reviewed for Rangeland Standards and Guidelines. Assessments under the BLM Standards and Guidelines using a watershed approach are conducted on a 10-year cycle. The RFO staff began this watershed approach in 2001. It plans to complete the first round of these assessments in 2008. Initial efforts have concentrated on watershed management areas in the western portion of the RMPPA, where BLM-managed lands are most extensive.

Monitoring may include the establishment of baseline data collection. For example in 2004, the BLM RFO sponsored the USGS surface water gaging station 09258980, at Muddy Creek below Young Draw near Baggs, Wyoming to record streamflow and conductivity. Beginning in 2006, the USGS and BLM began collecting water quality samples periodically in an effort to develop a relationship between specific conductance and concentrations of total dissolved solids (TDS). This baseline data will be used to evaluate salt loading to the Colorado River system and natural gas development projects upstream

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